

MULTIMEDIA



UNIVERSITY

STUDENT ID NO

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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2017/2018

DEM5018 – ENGINEERING MATHEMATICS 1
(DEE)

21 OCTOBER 2017
2.30 p.m - 4.30 p.m
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 6 pages (3 pages with 5 questions and 3 pages for appendix)
2. Answer **ALL** questions. All necessary working steps must be shown.
3. Write all your answers in the answer booklet provided.

QUESTION 1 [15 Marks]

- a) At Permata restaurant, the average starting salary for a new waiter is RM1500, but the actual salary could differ from the average by as much RM200. Write and solve the inequality to find the range of the starting salaries.

[5 marks]

b)

Let $A = \begin{bmatrix} 2 & -3 & 3 \\ 1 & -1 & 5 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 4 & 7 \\ 1 & 3 & -4 \end{bmatrix}$

i) $A + B$

[2 marks]

ii) $A - B$

[2 marks]

iii) $-2A$

[2 marks]

c) Evaluate the limits

i) $\lim_{x \rightarrow 3} (3x^2 - 1)(2x^3 - 2x + 1)$

[2 marks]

ii) $\lim_{x \rightarrow -2} \frac{\sqrt{x^4 + 3x + 6}}{\sqrt{7 - x}}$

[2 marks]

QUESTION 2 [20 Marks]

a) Solve the following inequality:

i) $|3x + 12| \leq 15$

[4 marks]

ii) $|x - 2| > 22$

[4 marks]

b) Given $4y - 8x + 12 = 0$

i) Rewrite the given equation in slope-intercept form.

[2 marks]

ii) Give the slope and the co-ordinate of the y-intercept.

[2 marks]

iii) Sketch the graph of the given equation.

[2 marks]

c) Given that $\sin \theta = \frac{5}{7}$ and $\cos \theta = \frac{4}{5}$. Find

i) $\csc \theta$

[2 marks]

ii) $\sec \theta$

[2 marks]

iii) $\cot \theta$

[2 marks]

Continued...

QUESTION 3 [20 Marks]

a) Given $a = -2 - 4i$ and $b = 3 - 3i$, calculate:

i) $\bar{a}$ [1 mark]

ii) $\frac{\bar{a}}{b}$ [4 marks]

iii) $\overline{ab}$ [2 marks]

iv) $\overline{ab(a-b)}$ [3 marks]

b) Use inverse matrix method to solve the system.

$$-3x - 2z = -4$$

$$5x - y = -4$$

$$-4y + 3z = 22$$

[10 marks]

QUESTION 4 [30 Marks]

a) Let $f(x) = 2x + 2$ $g(x) = x^2 + 3$ and $h(x) = \frac{3x}{2x + 2}$

Find

i) $h \circ g \circ f$ [2 marks]

ii) $g \circ h \circ f$ [2 marks]

b) Evaluate the following limit:

$$\lim_{x \rightarrow \infty} (\sqrt{25x^2 + 9x} - 5x)$$

[4 marks]

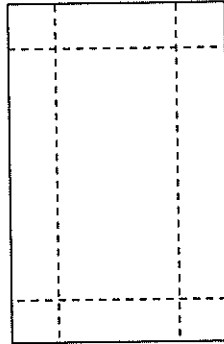
c) By using implicit differentiation, solve:

$$y = \sqrt[3]{\frac{(5x+4)(9x-1)}{x^2+1}}$$

[10 marks]

Continued...

- d) You are designing a rectangle poster to contain 50 inches² of printing with a 4 inches margin at top and bottom, and a 2 inches margin at each side. What overall dimensions will minimize the amount of paper used?



[12 marks]

QUESTION 5 [15 Marks]

- a) Prove the following identity:

$$\cot x + \tan x = \sec x \csc x$$

[7 marks]

- b) If $A = \begin{bmatrix} 2 & 1 \\ 3 & 2 \end{bmatrix}$, find $|A|$ and A^{-1} , then prove that $(A^{-1})^{-1} = A$. Show all necessary workings.

[8 marks]

End of Page.

APPENDIX

A Standard Form of Circle Equation

$$(x - h)^2 + (y - k)^2 = r^2$$

B Fundamental Identities

- Even & Odd Properties: $\sin(-\theta) = -\sin \theta$ $\csc(-\theta) = -\csc \theta$
 $\cos(-\theta) = \cos \theta$ $\sec(-\theta) = \sec \theta$
 $\tan(-\theta) = -\tan \theta$ $\cot(-\theta) = -\cot \theta$
- Reciprocal identities: $\csc \theta = \frac{1}{\sin \theta}$, $\sec \theta = \frac{1}{\cos \theta}$, $\cot \theta = \frac{1}{\tan \theta}$
- Pythagorean identities: $\sin^2 \theta + \cos^2 \theta = 1$, $\tan^2 \theta + 1 = \sec^2 \theta$,
 $1 + \cot^2 \theta = \csc^2 \theta$
- Sum/Difference Formula for Cosine:
 $\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$
- Sum/Difference Formula for Sine:
 $\sin(A \pm B) = \sin A \cos B \pm \sin B \cos A$
- Sum/Difference Formula for Tangent:
 $\tan(A \pm B) = \frac{\tan A \pm \tan B}{1 \mp \tan A \tan B}$
- Double Angle Formula: $\cos 2A = \cos^2 A - \sin^2 A$
 $= 1 - 2\sin^2 A$
 $= 2\cos^2 A - 1$
 $\sin 2A = 2\sin A \cos A$
 $\tan 2A = \frac{2\tan A}{1 - \tan^2 A}$
- Half Angle Formula: $\sin\left(\frac{\alpha}{2}\right) = \pm \sqrt{\frac{1 - \cos \alpha}{2}}$
 $\cos\left(\frac{\alpha}{2}\right) = \pm \sqrt{\frac{1 + \cos \alpha}{2}}$
 $\tan\left(\frac{\alpha}{2}\right) = \pm \sqrt{\frac{1 - \cos \alpha}{1 + \cos \alpha}}$

C Relations between Polar and Rectangular Coordinates

$$x = r \cos \theta; \quad y = r \sin \theta; \quad r = \sqrt{x^2 + y^2}; \quad \tan \theta = \frac{y}{x}$$

D Products and Quotients in Polar Form

- $z_1 z_2 = r_1 r_2 [\cos(\theta_1 + \theta_2) + i \sin(\theta_1 + \theta_2)]$
- $\frac{z_1}{z_2} = \frac{r_1}{r_2} [\cos(\theta_1 - \theta_2) + i \sin(\theta_1 - \theta_2)]; \quad z_2 \neq 0$

E DeMoivre's Theorem

- Powers of Complex Numbers on Polar Form:

$$z^n = r^n (\cos n\theta + i \sin n\theta)$$
- Roots of Complex Numbers in Polar Form:

$$z_k = \sqrt[n]{r} \left[\cos \left(\frac{\theta}{n} + \frac{2\pi k}{n} \right) + i \sin \left(\frac{\theta}{n} + \frac{2\pi k}{n} \right) \right]$$

$$k = 0, 1, 2, \dots, n-1$$

F Derivatives of Trigonometric Functions

$$\begin{aligned} \frac{d}{dx} [\sin x] &= \cos x & \frac{d}{dx} [\cos x] &= -\sin x & \frac{d}{dx} [\tan x] &= \sec^2 x \\ \frac{d}{dx} [\sec x] &= \sec x \tan x & \frac{d}{dx} [\cot x] &= -\csc^2 x \\ \frac{d}{dx} [\csc x] &= -\csc x \cot x \end{aligned}$$

G The Chain Rule

If $y = f[g(x)]$ and $u = g(x)$, then $y = f(u)$:

$$\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx} \quad \text{or} \quad \frac{d}{dx} [f(u)] = f'(u) \cdot \frac{du}{dx}$$

H Derivative of the Exponential & logarithmic Function

$$\begin{aligned}\frac{d}{dx}[e^x] &= e^x; & \frac{d}{dx}[e^u] &= e^u \cdot \frac{du}{dx}; & \frac{d}{dx}(a^x) &= a^x \ln a \\ \frac{d}{dx}[\ln x] &= \frac{1}{x}; \quad x > 0; & \frac{d}{dx}[\ln u] &= \frac{1}{u} \cdot \frac{du}{dx}; \\ \frac{d}{dx} \log_a x &= \frac{1}{\ln a} \cdot \frac{1}{x} = \frac{1}{x \ln a}\end{aligned}$$

I Derivative of Inverse Trigonometry Function

$$\begin{aligned}\frac{d}{dx}[\sin^{-1} x] &= \frac{1}{\sqrt{1-x^2}} & \frac{d}{dx}[\cos^{-1} x] &= -\frac{1}{\sqrt{1-x^2}} & \frac{d}{dx}[\tan^{-1} x] &= \frac{1}{1+x^2} \\ \frac{d}{dx}[\csc^{-1} x] &= -\frac{1}{x\sqrt{x^2-1}} & \frac{d}{dx}[\sec^{-1} x] &= \frac{1}{x\sqrt{x^2-1}} & \frac{d}{dx}[\cot^{-1} x] &= -\frac{1}{1+x^2}\end{aligned}$$

J Derivative of Hyperbolic Function

$$\begin{aligned}\frac{d}{dx}[\sinh x] &= \cosh x & \frac{d}{dx}[\cosh x] &= \sinh x & \frac{d}{dx}[\tanh x] &= \sec^2 x \\ \frac{d}{dx}[\sec hx] &= -\sec hx \tanh x & \frac{d}{dx}[\coth x] &= -\operatorname{cosec}^2 x \\ \frac{d}{dx}[\csc hx] &= -\csc hx \coth x\end{aligned}$$

K The Second Derivative Test

Suppose f'' is continuous near c .

If $f'(c) = 0$ and $f''(c) > 0$, then f has local minimum at c .

If $f'(c) = 0$ and $f''(c) < 0$, then f has local maximum at c .